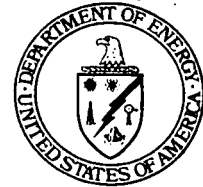




## Department of Energy

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MAY 5 1997  
DOE-0905-97

Mr. James A. Saric, Remedial Project Director  
U.S. Environmental Protection Agency  
Region V-SRF-5J  
77 West Jackson Boulevard  
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager  
Ohio Environmental Protection Agency  
401 East 5th Street  
Dayton, Ohio 45402-2911

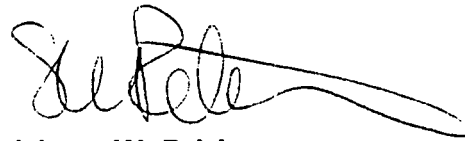
Dear Mr. Saric and Mr. Schneider:

### TRANSMITTAL OF CLARIFICATIONS TO U.S. ENVIRONMENTAL PROTECTION AGENCY AND OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS

The U.S. Department of Energy (U.S. DOE) is pleased to transmit the Clarifications to the U.S. Environmental Protection Agency (U.S. EPA) and Ohio Environmental Protection Agency (OEPA) Comments. These clarifications were requested by the regulatory agencies. The proposed resolution for these storm water management issues at the On-Site Disposal Facility (OSDF) are enclosed.

If you or your staff have any questions regarding this transmittal, please contact Rod Warner at (513) 648-3156.

Sincerely,

  
Johnny W. Reising  
Fernald Remedial Action  
Project Manager

FEMP:Warner

Enclosure: As Stated

cc w/enc:

N. Hallein, EM-42/CLOV  
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R. Beaumier, TPSS/DERR, OEPA-Columbus  
T. Schneider, OEPA-Dayton (3 copies total of enc.)  
F. Bell, ATSDR  
D. S. Ward, GeoTrans  
R. Vandegrift, ODOH  
R. Geiger, PRC  
T. Hagen, FDF/65-2  
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S. Peterman, DOE-FEMP  
J. Reising, DOE-FEMP  
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U. Kumthekar, FDF/64  
C. Little, FDF/2  
C. Messerly, FDF/64  
T. Walsh, FDF/65-2  
EDC, FDF/52-7

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RESPONSES TO OHIO ENVIRONMENTAL PROTECTION AGENCY  
COMMENTS  
DRAFT FINAL LEACHATE/LINER  
COMPATIBILITY STUDY

Commenting Organization: Ohio EPA

Commentor: OFFO

Section #: Pg #: Line #: Code: M

Original Comment #: 1

**Comment:** *The data analysis does not support the conclusions that the leachate caused no observable effects on the physical or mechanical properties of the geomembranes. The analysis of the data performed by GeoTrans shows that an observable effect does exist. The fact that these effects are generally not deleterious to the mechanical properties does not alter the general conclusion that an effect does exist. Furthermore, GeoTrans' data analysis is limited to only two of the liner materials GSE-SLT and Polyflex. GeoTrans did not evaluate the data for the NSC, GSE-Gundle or the Serrot geomembranes.*

**Response:** DOE agrees that the analysis methodology used does indicate observable effects in some of the tests. However, as is discussed in the report and the following responses to comments, these observable effects are either artifacts of inherent material and testing variabilities or the observed effects are not significant with respect to the mechanical properties of the liner materials.

**Action:** No action is required.

**FOR  
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Commenting Organization: OEPA

Commentor: GeoTrans, Inc

Section #: 2.3 Selection of Test Leachate Pg. #: Code: c

Original Comment #: 2

Comment: *In retrospect, it would have been more conservative to use concentrated leachate to mimic the long-term effects.*

Response: The use of concentrated leachate to simulate long-term effects could have overestimated the potential effect by increasing the concentration of chemical and radioactive constituents above the threshold levels below which no significant degradation occurs. It should be remembered that the main component of leachate is rainwater. In light of the expected low concentrations of constituents of concern in leachate within the OSDF, and the relatively short time in which leachate will be produced by the OSDF, the use of FEMP perched ground water for the test leachate is considered appropriate and conservative.

Action: No action is required

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: 2.3 Selection of Test Leachate Pg. #: 2-4 Code: M

Original Comment #: 3

Comment: *In the First bullet on this page Fluor Daniel Fernald (FDF) implies that the concentrations of VOCs are below a level of concern for HDPE degradation. However, on Table 2-1 on page 2-5, the range of concentrations of PCE and TCE are up to 10,000 ppb. The test leachate concentrations for these compounds are 90 and 650 ppb respectively. The test leachate does not conservatively represent the perched groundwater considering that some perched waters in the production area have concentrations of over 2000 ppb PCE (Well 1145 and Pit Leachate 1776) and over 1400 ppb PCE (Wells 1031 and 1145 and several others). What concentrations of VOCs are considered by the manufacturers to be of concern for degradation of their products?*

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## Response

The test leachate is intended to represent a conservative estimate of the anticipated leachate in the OSDF. While isolated locations of perched ground water may exhibit higher concentrations of individual constituents than the test leachate. In general, the concentrations of VOCs at the FEMP are in general quite low. For example, Table 3-7 of the Leachate Liner Compatibility Study Work Plan (LLCSWP) indicates that only one of the seven perched ground-water plumes beneath the FEMP has significant (i.e., 10,000 ppb) concentrations of trichloroethene and tetrachloroethene. The next highest reported concentrations for individual plumes are only 290 ppb and 30 ppb, respectively. Furthermore, perched ground water in the form of free liquid will not be placed in the landfill. Soil will comprise approximately 85 percent of the material to be disposed in the OSDF. Table 3-3 of the LLCSWP provides data on the presence of VOCs in impacted soils at the FEMP. This table generally indicates low concentrations of VOCs. For example, with respect to trichloroethene in soil in the depth range of 0 to 1.5 feet, 46 detections occurred in 337 measurements. The average trichloroethene concentration for the 46 sample detections was 3.304  $\mu\text{g}/\text{kg}$ . It should also be noted the impacted material excavation schedule and the layered-lift placement strategy for the OSDF will cause any soil excavated from a relative "hot spot" to be spread over a fairly wide area. Furthermore, rainwater that falls into the active OSDF cell will have a significant diluting effect.

The selection of the perched ground water from the Plant 6 Clarifier Pit provided a readily obtainable supply of test leachate that exceeds the concentrations of constituents anticipated in the OSDF leachate. As stated in Section 2.3.6 of the LLCSWP, experience has shown that in order for organic chemicals to significantly impact the performance of HDPE geomembranes, they must be present at high concentrations (i.e., typically greater than 10 percent by weight or 100,000 ppm or 1,000,000 ppb). A concentration of approximately

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10 percent is much greater than the total organic carbon (TOC) of the test leachate which is 93 mg/l (0.0093 percent by weight).

Action: No action is required.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: 3.5 Summary of Results

Pg. #: 3-9 Code: C

Original Comment #: 4

Comment: *The column titled "Interpretation" on Table 3-1 seems to be altered. For the physical properties, all entries in the Interpretations column begin with "Extractable content increase most likely due to...." Please update this table.*

Response: DOE agrees with the comment.

Action: The table is being revised to provide the appropriate summary information from Appendix B for the Final LLCSEFR. See Table 3-1 and Figures 3-1 through 3-4 attached.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: 4.0 Conclusions Pg. #: 4-1 Code: M

Original Comment #: 5

Comment: *Please explain the basis of the conclusions stated in the last paragraph on this page. If the design life of the landfill is considered in the data evaluation, any measurable variation in the properties tested would warrant concern. Unfortunately, USEPA Method 9090A provides very few details of the methods to evaluate the test data that is collected.*

Response: The final paragraph of Section 4, Conclusions, provides a summary of the test results from a broad perspective. The individual test results are summarized in Table 3.1. The significance of measured test variations are discussed in the summary of each test in

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Appendix B. The commentor expresses a valid concern that when design life is considered in the evaluations, any measurable negative variation in properties could be problematic. As noted in the discussions of each test in Appendix B, no consistent test variations were observed that indicate degradation of the HDPE liner material.

It should be noted that while detailed calculations have not been carried out, the timeframe for significant leachate generation is likely 3 to 10 years. Thus the exposure period in the test was approximately 1/12th to 1/40th of the potential exposure period in-situ. The concentrations of VOCs and radionucleides in the test leachate is estimated to be significantly higher than the expected leachate. The purpose of the higher temperature exposures is to simulate even longer times than the actual 120-day exposure period. Therefore, the exposure in the test cells is estimated to be on the order of 1/5 to 1/20 of the potential exposure period in-situ.

Action: Discussions of test results in Appendix B is being expanded to address the significance of material property variations over the design life where appropriate.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc

Section #: Appendix B. Geomembrane Leachate USEPA Method 9090 Code: M

Original Comment #: 6

Comment: *Please explain the rationale for the method of the evaluation of data from compatibility testing which was performed using USEPA Method 9090. The aforementioned EPA method indicates the data should be analyzed by looking at the percent change in each parameter. The data analysis provided consists of calculating the mean and the standard deviation (SD) for 2 to 5 controls as a group and 2 to 5 experimentals as a group for each exposure period. For example, in Appendix B 2.1, the masses of the four specimens have been averaged. An error bar is provided that graphically displays the*

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*estimated errors in this measurement. Averaging the controls and the experimentals is essentially providing manufacturing quality control, (that is how similar the test specimens weigh) not evaluating the effect of the leachate on the parameter of interest. The data would more appropriately be evaluated by calculating the mean and SD for the percent difference between the control and experimental for each specimen.*

Response: The EPA Method 9090 indicates that results should be summarized in terms of the percent change in test parameter. The method does not call for calculation of percent change for individual test specimens. The data interpretation procedure used in the LLCSEFR is consistent with this method requirement.

Nonetheless, DOE concurs with the comment regarding the use of the mean and standard deviation for evaluation of geomembrane physical parameters. The important factor when evaluating these parameters is the comparison of the percent change for each specimen within the group. While the accuracy of the measurements allows the conclusion that a measurable change has occurred, the magnitude of the change does not indicate a degradation of the properties of the HDPE geomembrane

The calculation of the mean and standard deviation for each group of control specimens and the test specimens is appropriate for the mechanical tests. The control specimens are independent of the test specimens (i.e., the same specimen was not tested before and after exposure to leachate as is the case with physical parameter specimens) because the test destroys the specimen. The primary purpose of the control specimens was to provide a method to evaluate test variation due to sample decontamination after exposure. As stated in the LLCSEFR, the procedure for evaluating whether a significant change has occurred includes comparison of the mean of



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the test specimens to the control mean plus or minus one standard deviation. The results of this test are, in most cases, identical to the results obtained by the t-test performed on the test results by the commentator. The method presented in the approved LLCSPW provides a conservative, yet procedurally simple, means of determining potential significance.

Action: The presentation of data in Appendix B will be clarified to better illustrate the percent changes as appropriate.

The following specific changes in the data presentation will be made:

- the physical parameters test data will be reorganized to better show the mean percent change and standard deviation of the percent changes for each exposure period;
- the error bar figures will be replaced with a standard deviation of percent change band to better illustrate the significance of variations in measurements;
- a figure scale will be selected to better reflect any significant trends in percent changes;
- the mechanical properties test data will be reorganized to better show the relationships between control and exposed samples and to explicitly show whether the change in the exposed mean value is within one standard deviation of the control group mean; and
- other clarifications will be incorporated as required to clearly illustrate any trends and the comparison of trends between 23° and 50°C exposures.

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Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Geomembrane/Leachate, USEPA Method 9090 Code: C

Original Comment #: 7

**Comment:** The graphs of the percentage change for the different parameters are not drawn with scales that are appropriate to illustrate significant changes. These graphs should be prepared using more appropriate scales, so variations can be seen. The percent changes in the parameters are observable if plotted at an appropriate scale. Statistics must be used to indicate if these changes are statistically significant.

**Response:** The scale on the graphs were selected to allow the reader to visually assess if a significant change of the measured parameter had occurred. Presentation of small changes on an exaggerated scale could lead the reader to the conclusion that a significant change had occurred. As discussed in the previous responses (and in the following response to Original Comment #8), the statistical criterion presented in the LLC SWP (i.e., one standard deviation variance from the control sample) was used to provide a first evaluation of the data. It should be noted that 32 percent of the tests are expected to fall outside this range if a normal population distribution is assumed.

**Action:** See action proposed for Original Comment #6 above.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Geomembrane/Leachate USEPA Method 9090 Code: C

Original Comment #: 8

**Comment:** A statistical analysis was completed on some of the data presented in this report. The procedure was to calculate the mean and standard deviation of percent changes for select parameters and all exposure periods for materials GSE-SLT and Polyflex. The T-test was then performed to determine if 0 percent change (no effect) fell within the two tailed 90% confidence interval for a normal distribution. If this was the case, then the t-test did not statistically show an effect from

exposure to the leachate. The results of this statistical test for both materials and select parameters are included in Tables 1 and 2. The following comments on Appendix B are based on these results. An explanation of the statistical method used for the analyses follows.

In order to determine whether a given parameter changed significantly as a result of the materials test, the percentage change for each of the samples was calculated. If there was no change as a result of the tests, the mean percentage change is expected to be zero. Thus:

- $H_0$ : The arithmetic mean of the % change = 0; and
- $H_a$ : The arithmetic mean of the % change  $\neq$  0.

We have used a two tailed test because both positive and negative percent changes are possible and of interest. For the threshold level of significance we have used  $\alpha = 0.1$ . We have assumed the frequency distribution of % change to be normal.

For a sample size of five measurements ( $df=4$ ), the value for  $t_{0.025}$  is  $\pm 2.132$ . Our test statistic is:

$$t = \frac{(\text{sample mean} - \mu)}{(\text{sample standard deviation} / \text{square root of the sample size})}$$

For example, the percent change of the five results for the 30-day Mullen Burst Test on the GSE-SLT material were 3.03, 6.25, 11.11, 6.25, and 11.11. The mean of these values is 7.55 and the standard deviation is 3.51. In order to estimate whether the population mean is zero (given these sample variables) the test statistic becomes:

$$t = \frac{(7.55 - 0)}{(3.51 / (5)^{1/2})} = 4.81$$

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*Because this value lies outside the acceptance region of  $\pm 2.132$ , the null hypothesis is rejected and the percent change of the Burst Test measurements is said to depart significantly from zero (i.e., the testing had a significant effect). Although in this particular case, the observed effect is not deleterious.*

Response: DOE acknowledges the comment and the commentor's desire to apply a more rigorous statistical methodology to the test results. However, statistical analyses must be used in conjunction with other discriminators in order to evaluate the significance of any particular change. Among the other discriminators are:

- trends in the property change due to exposure with time;
- relative scatter of exposed property change versus control property;
- consistency of trends between 23°C and 50°C exposures; and
- magnification of trends at higher temperatures.

The T-test, as applied, is appropriate for analysis of the physical measurements of mass, thickness, and dimensions. For these measurements, the control and exposed samples were the same physical sample. The T-test, as applied, is not appropriate for analysis of testing which destroys the sample (due to destructive testing), including all those reported in Appendices B 2.4 through B 2.13. In these latter tests, the controls are specimens from the same geomembrane sheet which have been treated to the same decontamination procedure as the exposed specimens.

In the Mullen Burst strength testing cited, the changes were not considered significant because the strength changes had considerable

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scatter and did not indicate consistent trends which were magnified at the higher temperature. Therefore, the test results are not considered to be indicative of a significant degradation of the HDPE geomembrane.

Action: The above rationale for evaluation of test result significance will be more fully discussed in the Final LLCFR.

Commenting Organization: OEPA Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.1, Mass Pg. #: B-3 Code: C

Original Comment #: 9

Comment: For Mass, 1 of 4 data sets analyzed by the t-test indicated the GSE-SLT material was affected during the 120-day exposure period. The effect was shown to be a loss of mass. The conclusion of no measurable impact is questionable.

Response: DOE agrees that the t-test, as applied, does indicate a measurable variance for mass for the 120-day sample at 23°C. However, this variance is not considered significant when examined in accordance with the previously stated criteria and discriminators.

Action: Test results will be more fully discussed in Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.3, Dimensions

Pg. #: B-25 Code: C

Original Comment #: 10

Comment: For Width, 1 of the 4 data sets analyzed by the t-test indicated the GSE-SLT material was affected during the exposure period. The effect was shown to be a decrease in the material width. The conclusion of no measurable impact is questionable.

Response: See response to original comment #9 above.

Action: Test results will be more fully discussed in Final LLCFR.

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Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.4, Specific Gravity

Pg. #: B-36 Code: C

Original Comment #: 11

**Comment:** *For Specific Gravity, 7 of the 8 data sets analyzed by the t-test indicated for GSE-SLT and Polyflex materials were affected during the exposure periods. In 6 of 7 instances the effect was shown to be an increase in the specific gravity. The conclusion of no measurable impact is questionable.*

**Response:** DOE agrees that further discussion of the variation in specific gravity between control and exposed specimens is required. In the testing, the individual control specimens are not the same as exposed specimens and variations between the specimen pairs are of no significance; only mean values of the control and exposed specimens can be compared. While the changes between the means of control and exposed specimens is generally greater than the standard deviation of control specimens, the variation is not consistent with time nor with increased temperature.

**Action:** Additional discussion in Appendix B, Section 2.4 of the rationale for the conclusion that changes in specific gravity are not significant will be provided in the Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.5, Volatiles Loss Pg. #: B-42 to B-44 Code: C

Original Comment #: 12

**Comment:** *For Volatiles Loss, 3 of the 4 data sets analyzed by the t-test indicated for GSE-SLT material was affected during the exposure periods. In all instances the effect was shown to be an increase in the volatiles loss. The conclusion may be incorrect. The results of this test correlate well with the results of the specific gravity tests.*

**Response:** DOE agrees that an increase in volatile loss, with exposure time, can be inferred from the test results for GSE-SLT material. However, the

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use of t-test results to draw this conclusion may be inappropriate, because of the questionable accuracy of the t-test for a sample of size two (degrees of freedom = 1).

The discussion of the test presented in Appendix B 2.5 explains that the constituents lost as volatiles are primarily low molecular weight polyethylenes. This loss will not result in a degradation of the HDPE geomembrane which would affect the integrity of a waste containment system.

Action: Test results will be more fully discussed in Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.6, Extractables Content Pg. #: B-50 to B-52 Code: C

Original Comment #: 13

Comment: *For Extractables Content, 3 of the 8 data sets analyzed by the t-test indicated the GSE-SLT and Polyflex materials were affected during the exposure periods. In all instances the effect was shown to be an increase in the Extractables Content. The conclusion of no impact from exposure to the leachate is questionable. The comparison to results of specific gravity and volatiles loss indicates this effect is probably due to exposure to the leachate.*

Response: As mentioned in the previous response, use of t-test results to draw statistical inferences may be inappropriate owing to the small sample size of two. The discussion of the test (presented in Appendix B 2.6) explains the scatter in the extractable content values as probably due to random distribution of extractable constituents, which could be reflected in discrete samples. Therefore, it makes it impossible to draw conclusions on trends due to increased exposure with the limited amount of information available. Once again, a change in extractable content will not result in a degradation of the HDPE geomembrane which would affect the integrity of a waste containment system.

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Action: Test results will be more fully discussed in Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.7. Stress and Strain at Yield Pg. #: B-58 to B-61

Code: C

Original Comment #: 14

Comment: For Stress at Yield, 4 of the 8 data sets analyzed by the t-test indicated for GSE-SLT and Polyflex materials were affected during the exposure periods. In all instances the effect was shown to be an increase in the Stress at Yield.

For Strain at Yield, 4 of the 8 data sets analyzed by the t-test indicated for GSE-SLT and Polyflex materials were affected during the exposure periods. In all instances the effect was shown to be an increase in the Strain at Yield. The conclusion of no impact on the Stress and Strain at Yield of the materials from exposure to the leachate is questionable.

Response: As described in response to Original Comment # 8, the t-test, as applied for destructive test results analyzed herein, is inappropriate. As the commentor stated, there is some impact on these properties of the geomembrane due to increased exposure; however, no trends can be drawn due to the natural variability and scatter of the test results.

Action: The significance of this potential impact will be more fully discussed in the Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.8. Stress and Strain at Break Pg. #: B-82 to B-85

Code: C

Original Comment #: 15

Comment: For Stress at Break, 3 of the 4 data sets analyzed by the t-test indicated the GSE-SLT material was affected during the exposure



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periods. In all instances the effect was shown to be an increase in the Stress at Break

For Strain at Break, 2 of the 8 data sets analyzed by the t-test indicated the GSE-SLT material was affected during the exposure periods. In both instances the effect was shown to be an increase in the Strain at Break. The conclusion that there is no impact on the Stress and Strain at Break of the materials from exposure to the leachate is questionable.

Response: See response to Original Comment #14 above.

Action: The significance of this potential impact will be more fully discussed in the Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans. Inc.

Section #: Appendix B, Section 2.10, Initial Tearing Resistance Pg. #: B-139 to B-140

Code: C

Original Comment #: 16

Comment: For Initial Tearing Resistance, all of the data sets analyzed by the t-test indicated the Polyflex material was affected during the exposure periods. The conclusion that there is no impact on the Initial Tearing Resistance of the material due to exposure to the leachate is questionable.

Response: See response to Original Comment #14 above.

Action: The significance of this potential impact will be more fully discussed in the Final LLCFR.

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*Commenting Organization: OEPA**Commentor: GeoTrans, Inc.**Section #: Appendix B, Section 2.11, Hardness**Pg. #: B-151 Code: C**Original Comment #: 17*

*Comment: For Hardness, 2 of the 4 data sets analyzed by the t-test indicated the Polyflex material was affected during the exposure periods. In both instances the effect was shown to be an increase in the Hardness. The conclusion that there is no impact on the Hardness of the material due to exposure to the leachate is questionable.*

*Response: See response to Original Comment #14 above.*

*Action: The significance of this potential impact will be more fully discussed in the Final LLCFR.*

*Commenting Organization: OEPA**Commentor: GeoTrans, Inc.**Section #: Appendix B, Section 2.12, Puncture Resistance Pg. #: B-162 to B-163**Code: C**Original Comment #: 18*

*Comment: For Puncture Resistance, 2 of the 8 data sets analyzed by the t-test indicated the GSE-SLT and Polyflex materials were affected during the exposure periods. The conclusion that there is no impact on the Puncture Resistance of the material due to exposure to the leachate is questionable.*

*Response: See response to Original Comment #14 above.*

*Action: The significance of this potential impact will be more fully discussed in the Final LLCFR.*

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Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.13, Mullen Burst Strength Pg. #: B-174 Code: C

Original Comment #: 19

**Comment:** For Mullen Burst Strength, 5 of the 8 data sets analyzed by the t-test indicated the GSE-SLT and Polyflex materials were affected during the exposure periods. In 4 of the 7 instances the effect was shown to be an increase in the Mullen Burst Strength. The conclusion that there is no impact on the Mullen Burst Strength of the material due to exposure to the leachate is questionable.

**Response:** See response to Original Comment #14 above

**Action:** The significance of this potential impact will be more fully discussed in the Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans, Inc.

Section #: Appendix B, Section 2.14.1

Pg. #: B-180

Code: C

Original Comment #: 20

**Comment:** Please review and update the interpretations of the leachate/liner compatibility physical properties testing results. It would be helpful to indicate how these results will be used to predict the long-term compatibility of the leachate and the liner. Results of the specific gravity analysis indicated exposure to the leachate resulted in an increase in specific gravity. Mass and width of the GSE-SLT material were also affected.

**Response:** Interpretations of test results for the leachate/liner compatibility, and prediction of long-term effects using these test results, have been addressed in responses to Original Comments #5, #6, and #8. DOE acknowledges the commentor's remark on the effect on specific gravity, mass, and width due to increased exposure. However, these effects are not considered significant because of a lack of consistency or randomness, and will not result in a degradation of the HDPE

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geomembrane which would affect the integrity of a waste containment system.

Action: Interpretations will be more fully discussed in Appendix B in the Final LLCFR.

Commenting Organization: OEPA

Commentor: GeoTrans. Inc.

Section #: Appendix B, Sect. 2.14.2

Pg #: B-180

Code: C

Original Comment #: 21

Comment: *Please review and update the interpretations of the leachate/liner compatibility mechanical properties testing results. It would be helpful to indicate how these results will be used to predict the long-term compatibility of the leachate and the liner. Results of many of the mechanical properties test indicated an effect on the liner from exposure to the leachate.*

Response: See response to Original Comment #20 above.

Action: Interpretations will be more fully discussed in the Final LLCFR.

**TABLE 3-1**  
**SUMMARY OF USEPA METHOD 9090 TEST RESULTS**

Property		Appendix	Results																				Interpretation															
			Maximum % Std. Deviation of Control Group					Maximum % Change to Property					Comparison <sup>A</sup> With One Std. Deviation					Temporal Trends <sup>B</sup>										Thermal Trends <sup>C</sup>										
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5						
Physical Properties																																						
Mass		B 2.1	0.01	0.06	0.40	0.20	0.40	0.02	0.10	0.2	0.10	0.1	✓	✓	×	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Thickness		B 2.2	1.50	0.60	2.00	1.10	2.00	1.00	0.60	-0.4	-2.0	-2.5	✓	✓	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Dimensions: Length		B 2.3	0.90	0.10	0.20	0.70	0.20	0.50	0.20	-0.1	-0.4	0.4	✓	✓	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Dimensions: Width		B 2.3	0.20	0.10	0.20	0.10	0.20	0.20	-0.2	-0.1	0.1	0.00	✓	✓	×	×	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Specific Gravity		B 2.4	0.20	0.05	0.10	0.05	0.10	0.40	0.10	0.30	0.30	-0.4	×	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Volatiles Losses		B 2.5	✓	0.1	0.1	1.5	1.1	479	219	1624	1115	658	×	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Extractables Content		B 2.6	8	18	78	31	32	750	1840	1905	179	174	×	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Mechanical Properties																																						
Stress at Yield	Roll	B 2.7	5.0	2.0	3.0	4.5	5.5	-11	2	-10	-7	0.5	×	✓	×	×	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.7	3.0	3.0	3.5	3.0	4.0	15	9	-5.1	13	-0.5	×	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Strain at Yield	Roll	B 2.7	6.0	0.0	0.5	4.0	6.0	-7	1	-12	-6	12	✓	✓	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.7	6.0	5.0	4.5	6.5	9.5	-11	-9	16.5	-12	10	✓	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Stress at Break	Roll	B 2.8	-4.0	9.0	9.5	18.0	17.0	-14	11	-7	18.5	24.5	×	×	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.8	43.0	5.0	7.0	26.5	28.5	19.5	-12	-11	-44	25.5	×	✓	×	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Strain at Break	Roll	B 2.8	18.0	7.5	10.0	14.5	18.0	29	12	5.5	11	-3.1	✓	✓	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.8	21.0	4.5	5.5	15.5	21.0	17.5	5	-10	-33	17.5	×	✓	✓	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Modulus of Elasticity	Roll	B 2.9	10.5	6.5	9.5	10.0	6.0	9.5	14	15	8	-16.5	✓	×	×	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.9	7.5	6.0	6.0	5.0	7.0	16.5	15.5	7.5	7	-17	✓	×	×	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Initial Tearing Resistance	Roll	B 2.10	6.0	4.5	4.0	5.5	5.5	7.5	11	-6	-10	9	✓	×	✓	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Cross-roll	B 2.10	4.5	4.0	3.0	3.0	4.5	-12	11	-7	11	12	✓	×	×	×	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Hardness		B 2.11	3.5	4.0	4.0	3.5	4.0	5	3	3.5	4.5	4.5	✓	✓	✓	✓	✓	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Puncture Resistance		B 2.12	4.0	1.0	1.0	4.5	5.5	6	7	5.5	8	10	×	×	✓	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Mullen Burst Strength		B 2.13	2.5	4.0	6.0	4.0	6.5	-12	-7.5	10	14	11.5	×	×	×	✓	×	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

**Geomembrane Types**

1. GSE-SET Geomembrane
2. NSC Geomembrane
3. GSE Gandle Geomembrane
4. Polyflex Geomembrane
5. Seron Geomembrane

**A. Comparison with One Std. Deviation**

- ✓ Percent changes were within one Std. Deviation for at least 5 out of 8 exposures
- ×- Percent changes were not within one Std. Deviation for at least 4 out of 8 exposures
- ✓ Zero percent property change was within one Std. Deviation for at least 5 out of 8 exposures
- ×- Zero percent property change was not within one Std. Deviation for at least 4 out of 8 exposures

**B. Temporal Trends**

- 1 General increase in percent change
- 1 General decrease in percent change
- Percent changes were relatively constant
- 1 Data exhibited randomness, i.e., no consistent trends

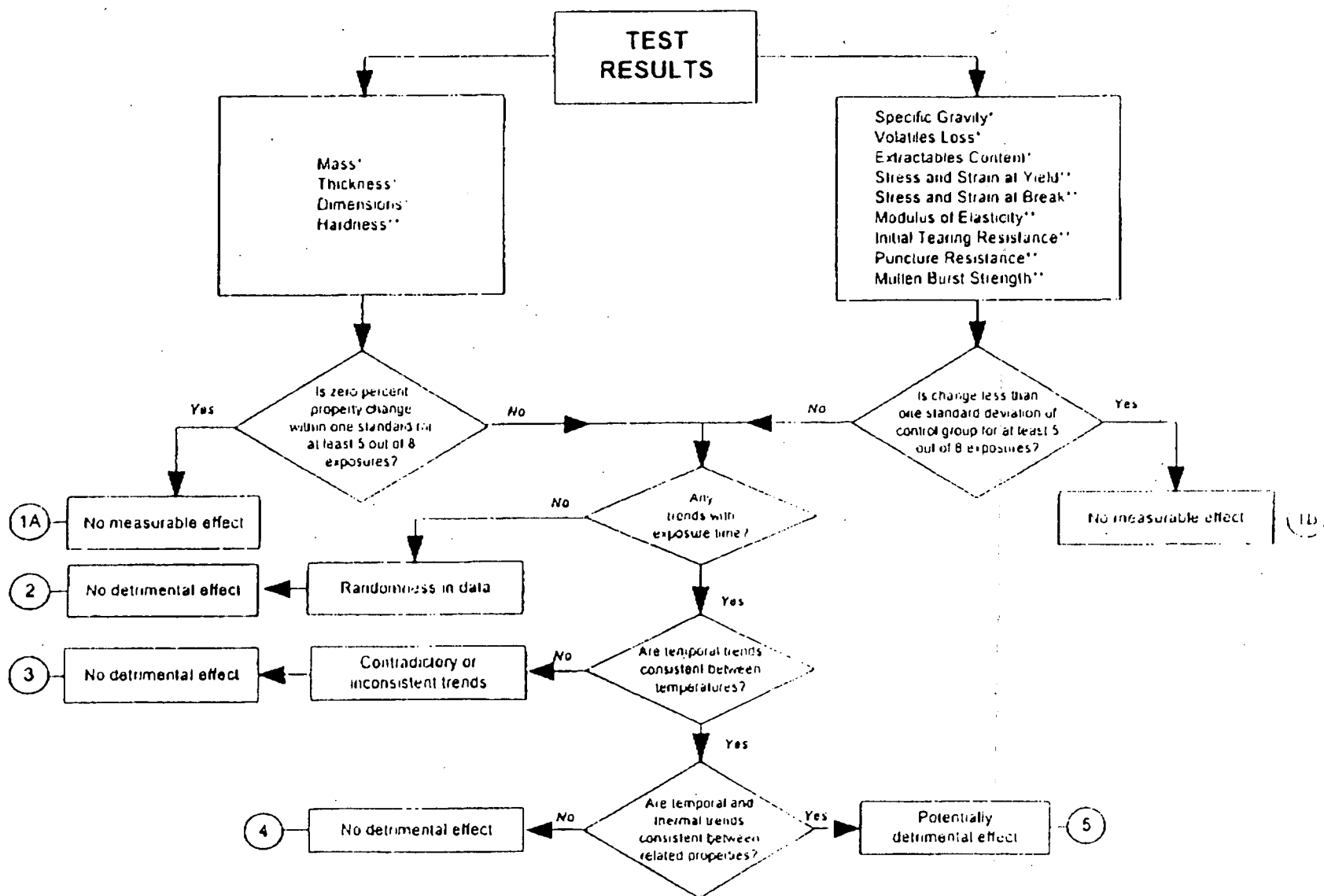
**C. Thermal Trends**

- Trends observed with exposure times were consistent between temperatures
- Trends observed with exposure times were inconsistent between temperatures
- Percent changes were relatively constant
- 1 Data exhibited randomness, i.e., no consistent trends
- 1 Trends observed with exposure times were not consistent between temperatures

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# FLOW DIAGRAM FOR INTERPRETATION OF USEPA METHOD 9090 TEST RESULTS



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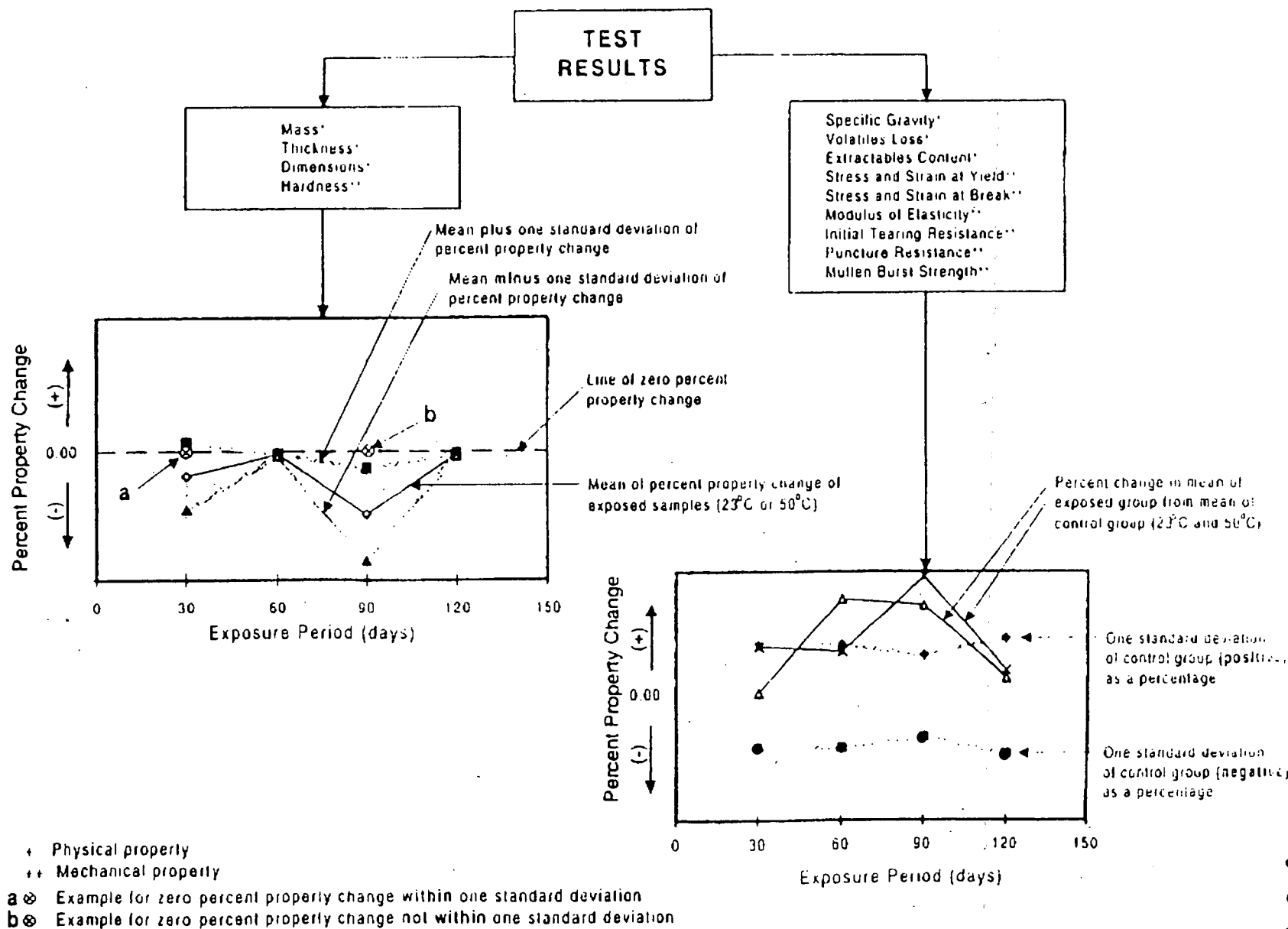
FIGURE NO. 3-1

PROJECT NO. GE3900-07.4

DOCUMENT NO. F9630165.FIG

FILE NO. FIG\_3-1.VSD

# ILLUSTRATION OF COMPARISON WITH ONE STANDARD DEVIATION



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FIGURE NO. 3-2

PROJECT NO. GE3900-07.4

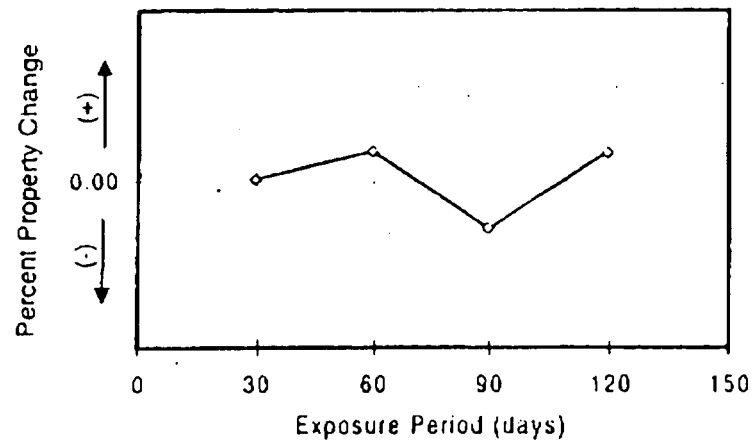
DOCUMENT NO. F9630165.FIG

FILE NO. FIG\_3-2.VSD

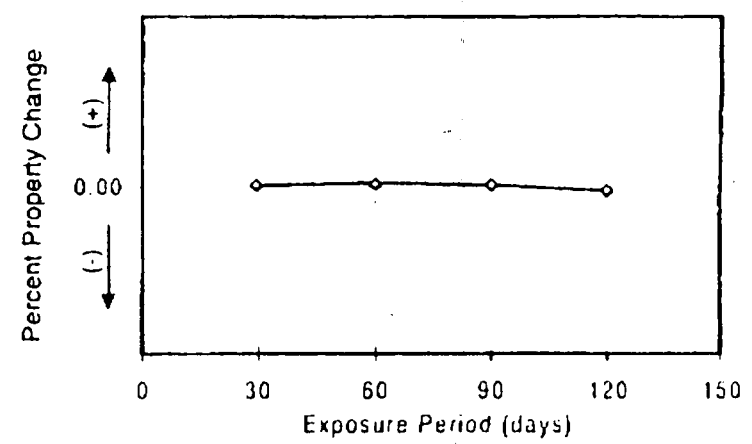
202

# ILLUSTRATION OF TEMPORAL TRENDS

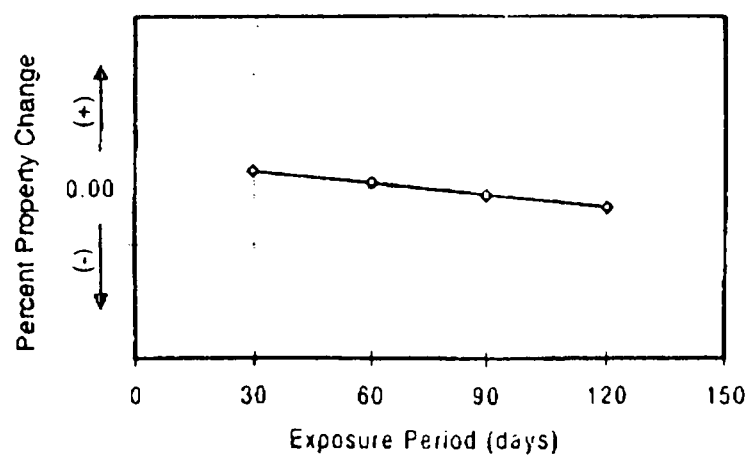
DATA EXHIBITED RANDOMNESS



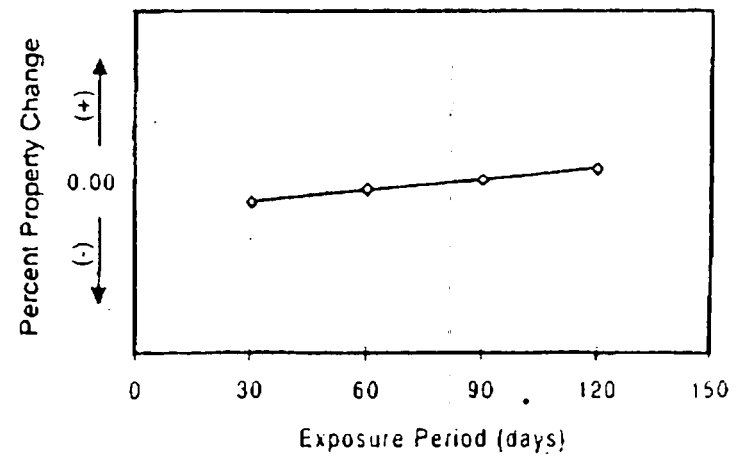
RELATIVELY CONSTANT PERCENT CHANGES



GENERAL DECREASE IN PERCENT CHANGE



GENERAL INCREASE IN PERCENT CHANGE



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FIGURE NO. 3-3  
PROJECT NO. GE3900-07.4  
DOCUMENT NO. F9630165.FIG  
FILE NO. \_3-3.VSD



# ILLUSTRATION OF CONSISTENCY BETWEEN TEMPORAL AND THERMAL TRENDS



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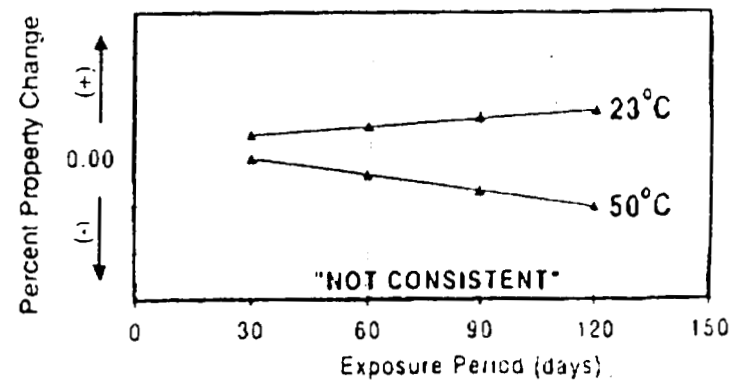
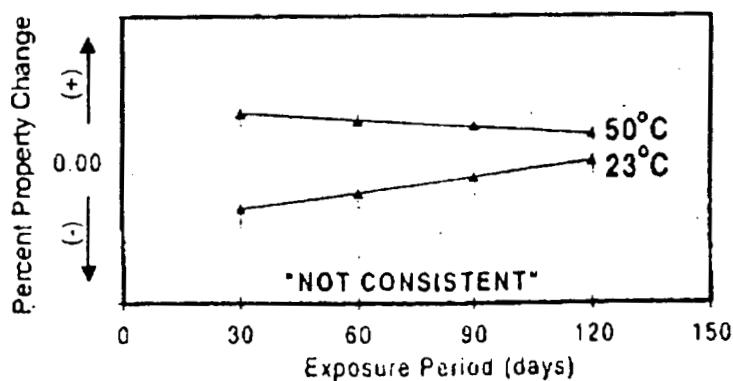
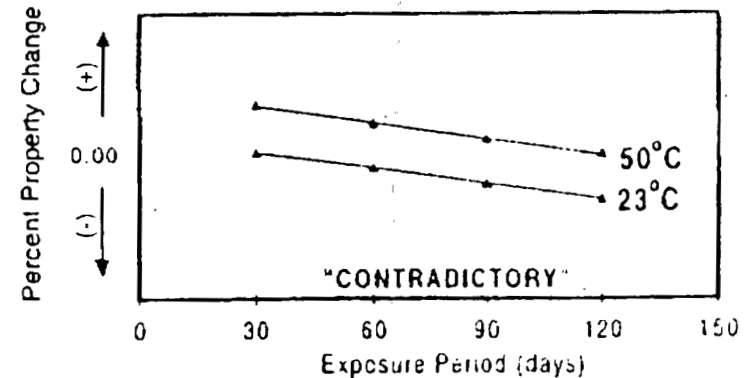
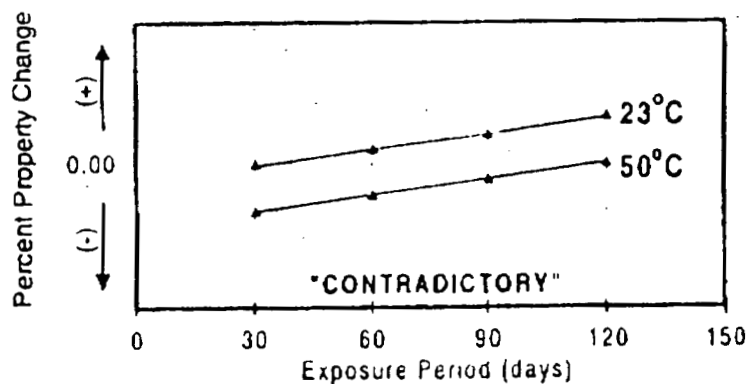
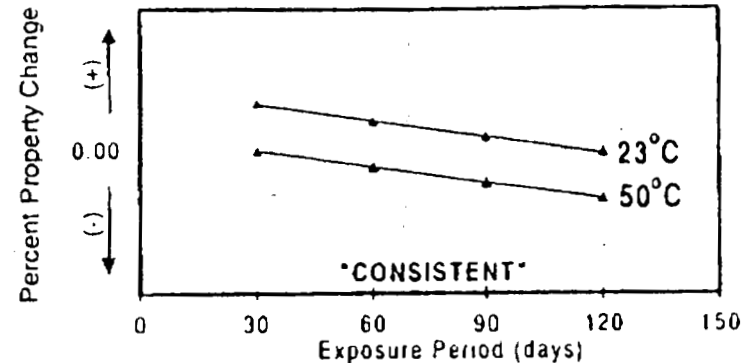
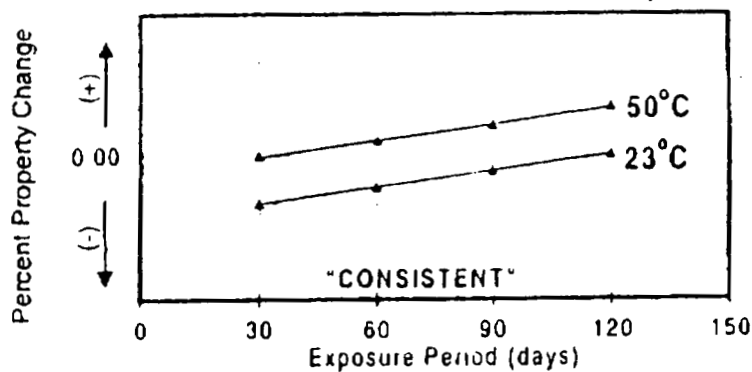
FIGURE NO. 3-4

PROJECT NO. GE3900-07.4

DOCUMENT NO. F9630165.FIG

FILE NO. FIG\_3-4.VSD

TOTAL P.24



NOTE: All lines shown in graphs are shown as 'straight lines' only for the purpose of illustration

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